Transportation Safety and Mobility

Developing a Left-turn Assist System for Signalized Intersections

Intersection collision avoidance systems help drivers maneuver cross traffic

DECEMBER 2013

Project Title:
Cooperative Intersection Collision Avoidance System (Phase II)

Task Number: 1037

Start Date: May 6, 2010

Completion Date: August 31, 2012

Product Category: New tool and equipment

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WHAT WAS THE NEED?

Over 25% of all U.S. intersection-related collisions—about 200,000 collisions annually—are attributed to left turns made against oncoming traffic, referred to as left turn across path of opposite direction or LTAP/OD. Two-thirds of the LTAP/OD collisions occur at signalized intersections.

Cooperative intersection collision avoidance systems (CICAS) have the potential to help drivers maneuver through cross traffic and intersections using vehicle-based and infrastructure-based technologies and communications systems, such as dedicated short-range communications (DSRC), to relay warnings to equipped vehicles. Caltrans, as part of the U.S. Department of Transportation CICAS Signalized Left Turn Assistance (SLTA) initiative, has been researching infrastructure-based systems that provide information to drivers to judge the gaps in oncoming traffic when performing a left turn, as well as inform them of the presence of pedestrians and cyclists.

WHAT WAS OUR GOAL?

The goal was to assess the technical feasibility of implementing a CICAS-SLTA system to increase safety and reduce collisions and evaluate the human factors in receiving and acting on information and warnings.

Test equipment used during the Richmond Field Station experiments

WHAT DID WE DO?

Caltrans, in partnership with the University of California, Berkeley Partners for Advanced Transportation Technology (PATH) program, implemented a CICAS-SLTA system and tested driver attitudes and behavior in terms of gap acceptance. The researchers evaluated vehicle positions, speeds, and zones of conflict for left turns. They also studied the components needed for the vehicle detection, pedestrian, and bicyclist sensor suites.

To assess the CICAS-SLTA system, the researchers put four test drivers representing a range of driving styles through LTAP-OD maneuvers. While another vehicle was approaching the intersection from the opposite direction, the drivers decided whether to turn in front of or behind the approaching vehicle As the drivers made these decisions, their predicted post-encroachment time (PET) was monitored, and the PET value was compared with the driver's action and expressed opinion about whether the maneuver merited an urgent or cautionary alert from the system.

WHAT WAS THE OUTCOME?

Analysis of the data from prior and recent field tests demonstrates that using predicted PET as the criterion for judging the hazard level associated with left-turn maneuvers is effective. In the pilot tests, the driver opinions agreed 78% of the time with the alert thresholds that were recommended as a function of the predicted PET value, validating the overall alert approach. In the cases where there was not complete agreement about the alert level, the disagreements were small and explainable, and some have been resolved by parameter value adjustments.

The DSRC radio system is able to broadcast the threat levels for the intersection to the approaching vehicles. The driver's DSRC system receives the information, and the in-vehicle computer can then associate the threat estimate with the location and direction of travel and decide which level of warning to give the driver.

WHAT IS THE BENEFIT?

Intersection collision avoidance systems use both vehicle-based and infrastructure-based technologies to help drivers approaching an intersection understand the state of activities within that intersection. CICAS technology can improve safety for motorists, pedestrians, and cyclists by warning drivers of the risk of collision.

LEARN MORE

To learn more about the CICAS initiative: *www.its.dot.gov/cicas*

Prototype driver-vehicle interface in an instrumented test vehicle
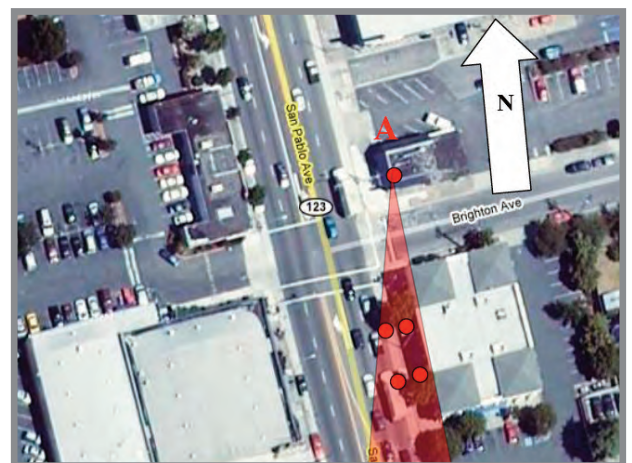
Sensor placement near the intersection of Brighton Avenue and San Pablo Avenue